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ABSTRACT

Changes in institutional research performance over time are examined to identify fluctuations and differences across five Carnegie types of institutions (research-I, research-II, doctoral-I, doctoral-II, and comprehensive-I). The focus is on whether certain types of institutions may be accumulating research advantage with respect to sponsored grant support and publication output. Three general indices of research output are included (changes in research orientation or potential, proportion of faculty receiving sponsored research support, and level of faculty publication productivity). An aggregate measure of total research output combines grants and publications. Data are from four national surveys of the American professoriate conducted in 1969, 1975, 1980, and 1988. Results suggest that: (1) changes in academic research performance spanning 20 years suggest that competition for academic research continues to be keen; (2) while research-I universities retain their dominant position, other types continue to contribute substantially to the academic research enterprise; (3) there is an increased emphasis on research at all types of institutions; and (4) research output indices have risen in all the categories examined. Tables and figures are included. Contains 28 references. (SM)

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CHANGES IN ACADEMIC RESEARCH PERFORMANCE OVER TIME: A STUDY OF INSTITUTIONAL ACCUMULATIVE ADVANTAGE

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CHANGES IN ACADEMIC RESEARCH PERFORMANCE OVER TIME: A STUDY OF INSTITUTIONAL ACCUMULATIVE ADVANTAGE

This study examines changes in institutional research performance over time to identify fluctuations and differences across five types of institutions: research-I, research-II, doctoral-I, doctoral-II and comprehensive-I institutions. To measure changes in institutional accumulative advantage, the study compares research performance indices such as the quality of faculty hired (percent of faculty from research-I institutions), the allocation of sponsored research support sources (e.g., federal, industry, and foundation), and the number of faculty publications. Data are from four national surveys of the American professoriate conducted in 1969, 1975, 1980, and 1988.

CHANGES IN ACADEMIC RESEARCH PERFORMANCE OVER TIME: A STUDY OF INSTITUTIONAL ACCUMULATIVE ADVANTAGE

Introduction

As research expenditures have risen, some observers of the higher education enterprise worry about a growing stratification in academic science such that only a few elite institutions are capable of conducting high quality research. Smith and Karlesky (1977) found a gap between the most eminent research universities and other institutions. According to their study, less established institutions were more susceptible to declines in external funding sources, reductions in research opportunities for younger scientists, and deterioration of instrumentation and other supporting resources needed for academic research. Bowen and Schuster (1986:156) found a general decline in faculty working conditions, such as obsolete equipment, inadequate supplies, and insufficient clerical help which may be especially burdensome to faculty at comprehensive colleges and universities where research interests must also be balanced with higher teaching loads.

Another example of strained competition between the so-called "have" and the "have not" institutions is evidenced by the growing dissatisfaction with federal peer review. A number of universities have circumvented competitive scientific review by hiring outside lobbyists and seeking direct legislative sponsorship (Graves, 1986; McCarthy, 1986). This development has

alarmed some groups (e.g., the Association of American Universities that represents the largest research universities). They call this approach "pork barrel" and warn that it could harm the peer review process, the hallmark of the scientific community (Graves, 1986). However, others counter saying that peer review unfairly favors a select group of eminent research institutions (Rose, 1986).

The purpose of this study is to examine changes in institutional research performance over time. In particular, it assesses whether certain types of institutions may be accumulating research advantage with respect to sponsored grant support and publication output.

Theoretical Framework

The conceptual framework of "accumulative advantage" is used to explore changes in research (Allison & Stewart, 1974; Cole & Cole, 1973; Merton, 1968; Zuckerman, 1977). Put simply, this theory suggests that the rich get richer as they accumulate advantage in terms of resources and recognition. As such, resources and recognition act as feedback loops that contribute to subsequent research support and productivity. A good example of accumulative advantage is Zuckerman's (1977) profile of Nobel laureates. They are more likely to have attended elite educational institutions, studied with prestigious mentors, graduated earlier, and been hired by elite institutions.

Accumulative advantage is seen as an important factor in explaining why faculty publication output varies so markedly (Allison & Stewart, 1974; Cole & Cole, 1973).

Advantage accrues not only to individuals but also to institutions. Perhaps the best example of this is the alleged "halo effect" thought to benefit large research universities in the federal grant peer review process (Cole, Rubin & Cole, 1978; Rose, 1986). The strong predictive power of institutional type and prestige on publication output indicates the important relationship of institutional affiliation. (See literature reviews by Finkelstein, 1984 and Creswell, 1985.) In a longitudinal study, Long (1978) found that publication patterns changed when natural scientists moved to new institutions, and they reflected the publication norms of the new institution. That is, if they moved to a university of highly productive faculty, they increased their output.

Methodology

To determine whether groups of institutions may be accumulating advantage relative to others, research output is compared across five Carnegie institution types including Research-I (Res-I), Research-II (Res-II), Doctoral granting-I (Doc-I), Doctoral-granting-II (Doc-II), and Comprehensive-I (Comp-I) institutions.

The study includes three general indices of research output: (1) changes in research orientation or potential (percent of faculty with Ph.D.'s and faculty preference for research over teaching), (2) the proportion of faculty receiving sponsored research support (government, industry, or foundation grants), and (3) the level of faculty publication productivity (two year publications and total books published). In addition, an aggregate measure of total research output combines grants and publications. To adjust for differences across disciplines, separate standardized measure of performance are computed.

Data are from four national surveys of the American professoriate conducted in 1969, 1975, 1980, and 1988. The Carnegie Commission on Higher Education sponsored the 1969 survey (Bayer, 1970; Trow, 1975) and the 1975 survey (Roizen, Fulton & Trow, 1978). The 1980 survey was conducted by the University of California at Los Angeles Higher Education Research Institute (1983) and the 1988 survey was conducted by the University of Michigan National Center for Research to Improve Postsecondary Teaching and Learning (Blackburn & Lawrence, 1989).

This study selected subsamples based on full-time teaching and research faculty holding the ranks of assistant, associate or full professors. To ensure further statistical control, only faculty from within eight liberal arts disciplines (biology, chemistry, English, history, psychology, sociology, political

science, and mathematics/statistics) were selected. These departments represent the humanities, natural sciences, and social sciences and have the largest number of faculty within the named disciplines.

The Population

Table 1 shows the distribution of participating survey institutions by Carnegie type. There is considerable institutional stability within Carnegie institution type across survey years, even though Carnegie has revised its classification twice since 1973 (in 1976 and 1987). The most significant fluctuation occurred with the redefinition of Res-I universities in 1987. However, all seven Res-I universities in the 1988 sample are also Res-I universities based on the 1976 criteria.

(Insert Table 1 about here.)

Table 2 compares the subsample N's by Carnegie institution type. Some of the variation in sample size reflects differences in sampling design among the surveys. For example, the large percentage of Res-I faculty in 1969 reflect the overrepresentation of high rated universities in 1969 (Roizen, Fulton & Trow, 1975:320-323). For the most part these fluctuations do not bias our analysis because mean (e.g., mean publication rates) and standardized data are reported by institution type. Also problems of sample comparability due to

response bias and sampling frame inadequacy are diminished

(Insert Table 2 about here.)

because the truncated subsamples exclude smaller institutions, such as liberal arts and two-year colleges. However, we do note a concern about potential response bias with the 1980 data which has a relatively low response rate (37%).[1] The concern is illustrated by the differences in faculty distribution between the 1969 and 1980 subsamples. (See Table 2.) These two distributions should be similar because the 1980 survey replicated the 1969 sampling framework and drew a representative one-third subset of the same institutions that participated in 1969 (HERI, 1983). However, the 1980 distribution suggests a lower response rate for Res-I faculty. (There is evidence that the HERI subsample was not random.)

Procedures and Variables

The study used four general indices of research output: (1) changes in research orientation or potential: (2) publication output, (3) sponsored grant support, and (4) combined grant and publication output. Specific variable definitions include the following:

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[1] The response rates in 1969, 1975, and 1988 were 60 percent, 52 percent, and 50 percent respectively.

1. PHD--percent of faculty holding a Ph.D.

2. RESPREF--percent of faculty primarily interested in research. This includes those faculty reporting interests either (1) leaning very heavily toward research or (2) both in teaching and research but leaning more toward research.

3. PEDIGREE--percent of faculty with their graduate training from the most selective institutions (i.e.., Res-I universities).

4. PUB2YR--number of self-reported professional writings published or accepted for publication in the last two year. This variable was recoded into mean categorical values to estimate the actual number of publications (.i.e., a category indicating a range of 5 to 10 publications was recoded 7.5).[2]

5. BKSALL--number of books and monographs published over a faculty member's career. This variable was recomputed by dividing by years since highest degree to adjust for differences by career age (Bayer & Dutton, 1977).

6. ALLGRT--externally sponsored grant support received in the

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[2] Mean categorical publication values attenuate data for the highest producing faculty (e.g., more than ten publications). However a comparison between recoded mean categorical values and the actual number of publications reported in 1988, the only survey with true interval publication data available, showed a high correlation (about .80) between the actual publications and recoded mean categorical values.

past year. This variable was created by recoding five variables that identify sources of support: federal, state and local government, industry, foundation, and other sources.[3]

7. TOTPROD--aggregate grant and publication output. A measure of total research output was developed by combining standardized scores from three variables: two year publications, total books, and sponsored research support within the past year.

All variables were recoded to ensure compa rability across time periods. Only PEDIGREE, the variable measuring faculty graduate training pedigree, was difficult to construct because its definition differed from survey to survey. For example, the 1969 survey identifies only 40 (of 53) Res-I institutions where faculty may have earned their highest degree. In addition, the 1980 survey uses a separate measure of institutional selectivity. Also, the data are missing on our 1975 data tape. We report the findings but suggest caution in making interpretations.

Adjusting for Differences by Discipline: In addition to presenting mean and percent figures, publication and grant output variables are converted into standardized scores. Z scores avoid potentially overstating performance for those institutions where a disproportionate share of faculty may have been in departments

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[3] We also examined institutional and departmental support but these grants are excluded from our analysis.

with higher than average publication rates and sponsored research. Standardization also adjusts for publication norms that have been found to vary by discipline (Blackburn, Behymer & Hall, 1978; Wanner, Lewis & Gregorio, 1981).

To standardize publications and grants, z scores are created separately for each of the eight disciplines and then summed them across disciplines. A new z score is then created from the sum of scores across disciplines. Standardized scores for total productivity (TOTPROD) were created by summing the three standardized scores for two year publication (PUB2YR), lifetime books published (BKSALL), and total grants received within the past year (ALLGRT) and creating a new z score from the aggregate measure.

Findings are presented both in raw data form and as standardized z scores in order to provide a more solid context to assess changes over time. ANOVAs are run across Carnegie types and include Scheffe multiple range tests to compare differences between groups.

Cautions Affecting Interpretation

In conducting these analyses several assumptions have been made that could potentially affect the measures that have been used. The principle ones are pointed out and their likely

consequences are indicated.

1. Summing individual departmental faculty productivity and taking that average as the measure of department faculty output clearly is a change in the level of analysis, from the individual to the organizational. Summing departments across institutions to calculate a productivity measure for an institution type raises the level of analysis one level higher and encompasses the same potential pitfalls. Both of these procedures were used here even though the potential complications are known. (See Young, Blackburn, Conrad, & Cameron, 1988).

Two scenarios illustrate the potential complications of the procedure that was employed. Suppose eight faculty in a department have produced 40 articles in the past two years. If all eight published five articles (or even four or six) the construct of department productivity as the sum of the individuals seems appropriate. However, if the 40 articles were produced by two faculty and six did nothing (or some similar distribution with a high standard deviation), one now has a couple of highly productive individuals but hardly a productive department. A similar example could be constructed by summing institutions within a type to compare with another type. Whether it makes conceptual sense to add and average institutional productivity units, irrespective of the arithmetic ease of the process, depends upon the variance of the sample being summed.

A problem with relying on Carnegie type as the unit of analysis is that research performance differs significantly across institutions within the same classification type. ANOVAs run on 1988 two year publications by institution yielded significant differences ($p < .05$) for four of the five Carnegie groups included in the study. Only Doc-I institutions ($p < .05$) did not vary across institutions ($p = .17$). This suggests some caution in assuming similarity in research performance within Carnegie classifications.

On the other hand, research performance levels when compared within departments appear to be more similar. ANOVAs run on 1988 two year publication by department (for Res-I only) showed no significance at six out of eight departments (e.g., ranging from p. = .36 for sociology to .70 for political science). However, 1988 mathematics (p.=.04) and biology (p=.004) departments showed significant difference across institutions.

2. The dollar values of the grants faculty have received is not known, only the number of grants (as self-reported).[4] The dollar amount is no doubt higher in later years, except in 1975, where

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[4] All data in these national surveys are self-reported and hence open to some measure of error. However, studies by Allison and Stewart (1974), Blackburn, Bobert, O'Connell and Pellino (1980), and Clark and Centra (1982) checking vitae against self reports of publications find faculty are generally fully honest in providing factual information about themselves.

National Science Foundation (1981:76) clearly shows a decrease in most funding sources, especially at the federal level which is the highest contributor. However, the value of succeeding dollars from a 1969 standard is clearly less. Also the real costs of conducting research may be higher today. In short, the quantitative consequences of an increased number of grants is most-likely over estimated by the data.

On the other side, we know that the number of institutional grants (their amounts are unknown), has increased appreciably since 1969, especially during the 1980's. Regardless of the magnitude of a grant, just having one seems to stimulate faculty to produce. The positive relationship demonstrated between sponsored grants and research output is quite likely accurate, despite the possibility of a dropping dollar value.

3. A subtle but not unimportant consideration is the possible changing value of an article at different points in time. Both the amount of journal space available to publish in and the number of faculty seeking to publish in that space differ at each point in time. That is, article values can change. Bieber and Blackburn (1989) have found that when the ratio of space to potential contributors is determined for 1972 (the base year they selected), faculty in 1988 are producing more than those in 1972 but each article must be deflated by about one-half. Said another way, our reported increased productivity is misleading,

at least in this regard.[5]

Despite what may seem like devastating limitations to this inquiry, one can still retain a high degree of confidence in the results that indicate different growth rates across institutional types, that is, accumulative advantage, since the potential distorting causes for the most part should exist nearly randomly throughout all institutional types.

Results

Findings are reported in three parts. First, changes in research orientation or potential of campuses to accumulate research advantage are shown (Figures 1-2, with Tables A1-A2 in Appendix A). Next, indices of research output, including publication performance and grants received, are presented (Figures 3-7, with Tables A3-A8 in Appendix A). Last, an aggregate measure of research output that combines grants and publications is displayed (Figure 8 with Table A9 in the Appendix). A summary of Scheffe tests findings on the grant and publication variables is presented in Table A10 of the Appendix.

Research Orientation: In general, the data suggest a greater emphasis on research orientation or potential. This

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[5] Actually we know this to be the case for psychologists and biologists and suspect it will turn out to be true for English faculty as well, the three disciplines used in their study.

observation is supported by the growing concentration of faculty holding Ph.D.'s as well as the increasing percentage of faculty whose interest in research is greater than in teaching. (See Figures 1 and 2.) A growth in Ph.D. faculty was most marked at Comp-I institutions between 1969 and 1975 (up from 74 percent to 84 percent), although this rate of growth has since tapered. Likewise, the proportion of Comp-I faculty with primary interest in research rose more between 1969 and 1975 (from 21.5 percent to 27.2 percent) than it has since. In fact, the 1988 percent is less than it was in 1975.[6]

(Insert Figures 1 and 2 about here.)

Publication Performance: Faculty publishing rates have risen at all types of institutions since 1988. (See Figure 3.) For example, the mean number of two year publications rose from 3.7 to 5.4 at Res-I universities between 1969 and 1975. (See Table A3 in the Appendix.)

(Insert Figure 3 about here.)

A similar picture emerges after two year publications figures are standardized by discipline before summing. (See

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[6] Trends in the graduate training pedigree of faculty is more difficult to discern because of missing data (in 1975) and changes in the variable definition for each of the other three survey years. However, it seems that research-I institutions retain their dominant share of faculty who receive their highest degrees from the most selective graduate institutions.

figures are standardized by discipline before summing. (See Figure 4.) Changes in Doc-I publication output are less than in Comp-I and Doc-II. An interesting change is greater competition between Doc-I and Doc-II institutions after 1969. Only in 1969 were differences significant ($p. < .05$) between these two groups (See Scheffe tests reported in Appendix Table A10). Also Comp-I's fell significantly behind all other institution types by 1988 (Scheffe test $p < .05$).

(Insert Figure 4 about here.)

Lifetime book publication totals also have risen since 1969. For example, the mean number of books published at Res-I's rose from 1.4 to 2.0 between 1969 and 1988 compared to an increase of 0.8 to 1.1 at Comp-I's. (See Appendix Table A5.)

Figure 5 presents standardized scores for the number of books published to adjust for differences by discipline. It shows considerable fluctuation in comprehensive institutions. In addition, while faculty across all types of institutions report more books published in 1988 than in 1969, book output has dropped off at Res-II's and Doc-I's since 1980, while Res-I's have increased.

(Figure 5 about here.)

Grant Support: The percent of faculty receiving federal support within the past year is slightly higher in 1988 than

1969. In 1988, for example, 59.7% of the Res-I faculty sample reported receiving federal support compared to 47.2% in 1969. Likewise, slight increases were reported by faculty in the other institutional groupings. (See Figure 6 and Appendix Table A7.)

(Insert Figure 6 about here.)

Doc-I institutions appear to be an increasingly strong contender for increased sponsored grant support from government, industry, and foundations. This is especially the case when the data are standardized. (Compare Figures 6 and 7 and Tables A7 and A8 in the Appendix.) As with two year publication rates, the relative position of comprehensive institutions to garner federal support has diminished. (Scheffe test became significant between Comp-I's and Doc-II's in 1988--See Appendix Table A10).

Total Publication and Grant Output: As with changes in sponsored grants, Doc-I institutions appear to be in a strong competitive position with Res-II institutions when publication (PUB2YR and BKSALL) and grants (ALLGRT) output are aggregated. (See Figure 8 and Appendix Table A9.) After equaling Res-II's in 1980, Doc-II's dropped slightly below their Res-II counterparts in 1988. Meanwhile, Res-II's overall research output has outpaced Res-I institutions between 1975 and 1988 (Scheffe tests showed significant differences between Res-I's and Res-II's in 1969, 1975, and 1980, but not in 1988).

(Insert Figure 8 about here.)

Overall research output has risen at Comp-I institutions, although there was a large drop in 1975 (Figure 8). However, Comp-I's have not kept pace relative to the other Carnegie groupings. In 1969, for example, there were no significant differences between Comp-I and Doc-II institutions (Scheffe test not significant). However in 1975, 1980, and 1988 Scheffe tests showed significant differences between these two groups ($P. < .05$).

Discussion/Significance

Changes in academic research performance spanning 20 years suggest that competition for academic research continues to be keen. While research-I universities retain their dominant position, other institution types, notably Res-II, Doc-I and Doc-II institutions, continue to contribute substantially to the academic research enterprise.

The data suggest an increased emphasis on research at all types of institutions. In addition to a stronger orientation toward research, such as greater faculty preference for research, research output indices have risen in all the categories examined by this study. For example, the mean number of books and two year publication rates generally are up and a greater percentage of faculty are receiving external support.

The most interesting signs of competition are from Doc-I institutions which appear to be approaching Res-II universities in their garnering of sponsor grants and overall research performance--aggregate grants and publications. At the same time faculty at Comp-I institutions have broadened their research emphasis by producing more books and obtaining more grants. But growth in research output at Comp-I's has not matched that of other institutional types. In fact Comp-I's have lost ground--in particular with respect to Doc-II institutions.

The data show no clear "winners" and "losers" of accumulated advantage. However, this may due to constraints inherent in the study's unit of analysis which aggregates institutions by Carnegie type. The variation in publications within Carnegie type suggest that such aggregation may be too broad. In fact, it may be masking evidence of institutional accumulative advantage. To test institutional accumulative advantage, it may be more appropriate to track subgroups of institutions by other criteria such as publication output or levels of grant support. The similarity of publication output within department suggest that departments, rather than institutions, may be a more conceptually sound level of analysis to assess the concept of accumulate advantage.

Figure 1: Percent of Faculty with Ph.D.'s

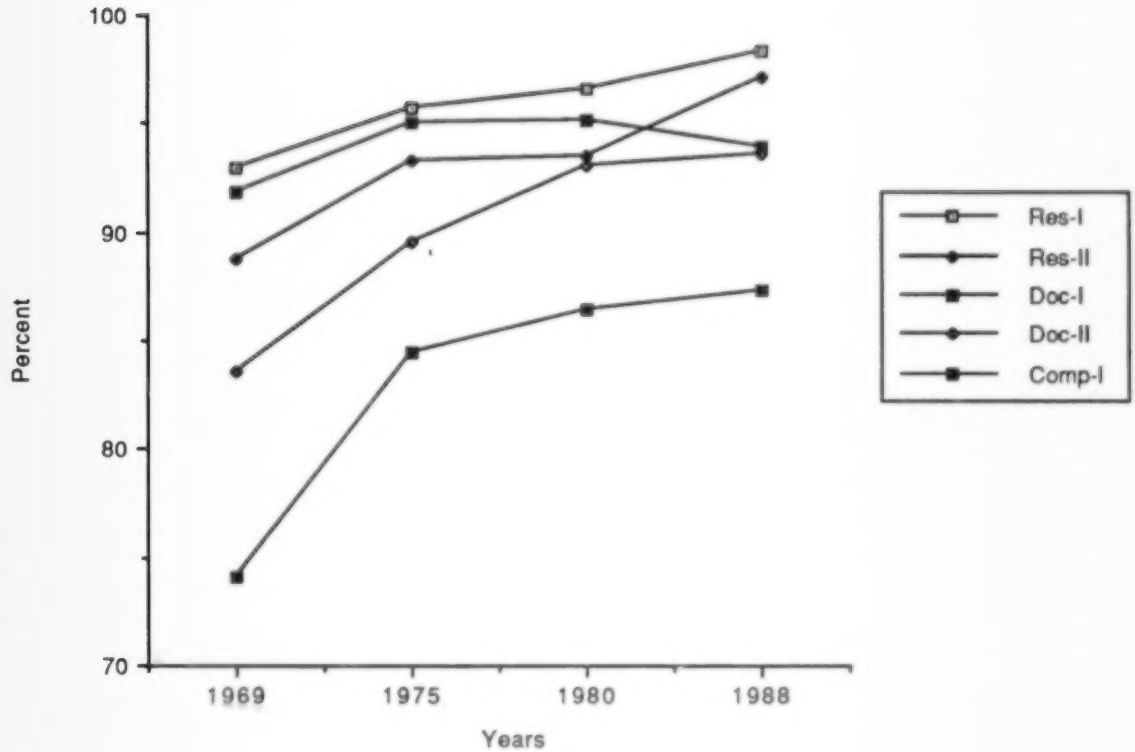

Figure 2: Percent of Faculty Primarily Interested in Research

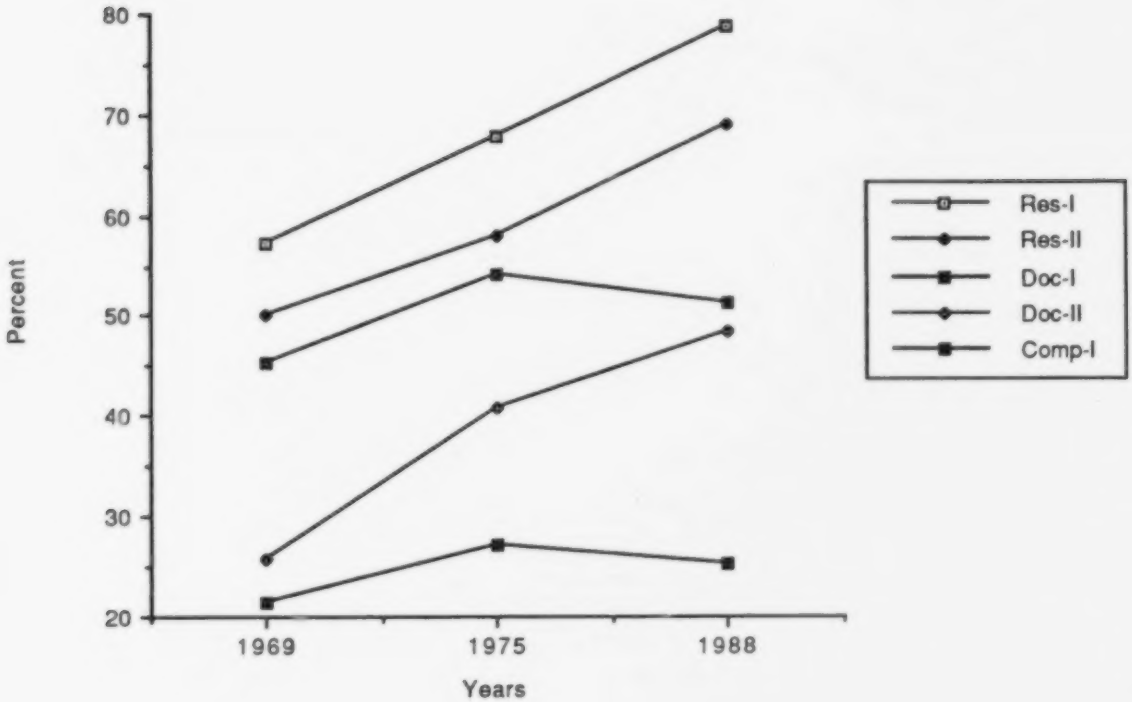

Figure 3: Mean Two Year Publication Rate

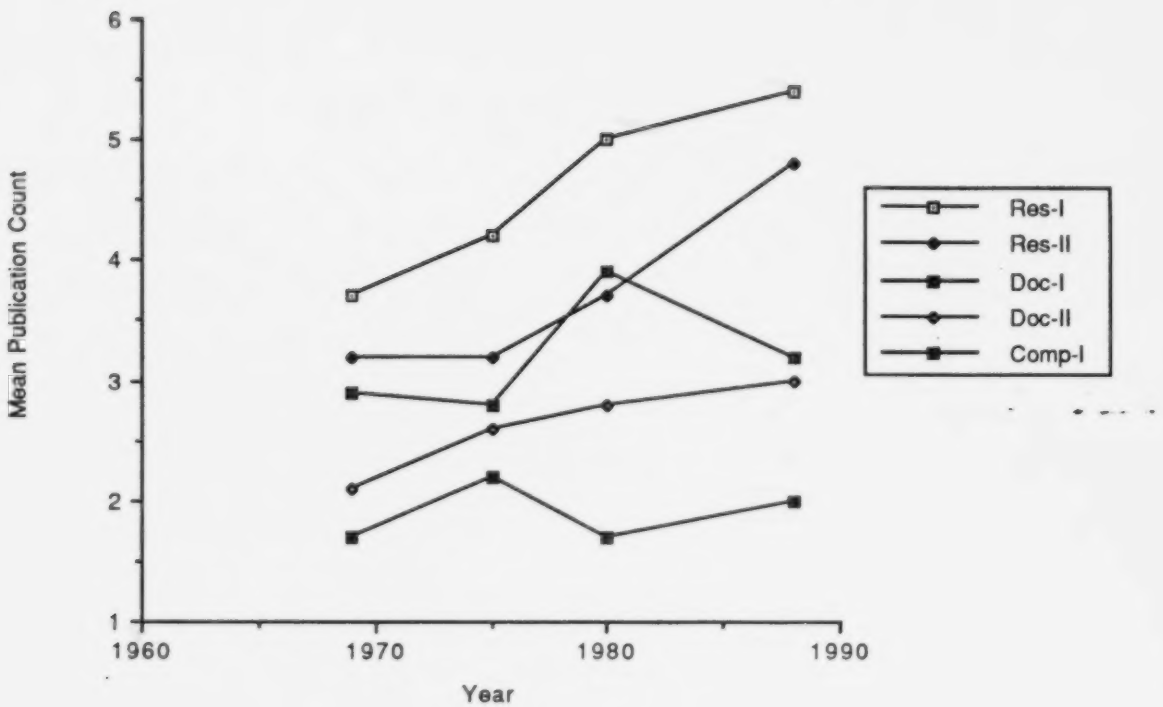

Figure 4: Standardized Two Year Publication Rate

(Adjusted for Differences by Discipline)

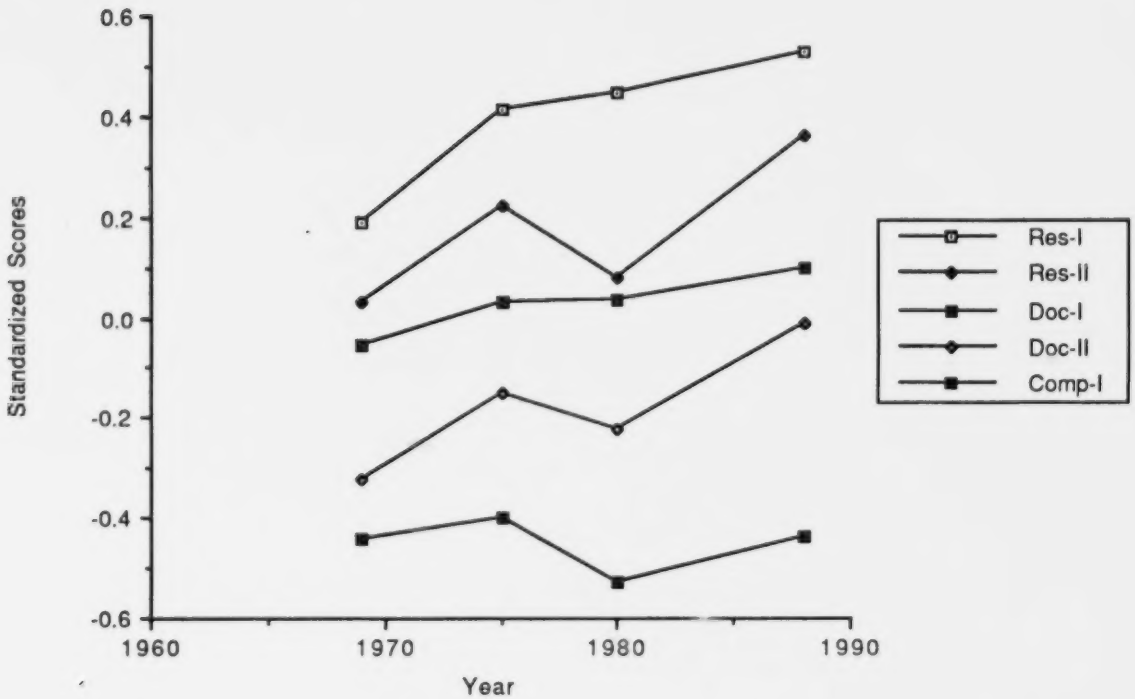

Figure 5: Standardized Lifetime Book Publications

(Adjusted for Differences by Discipline)

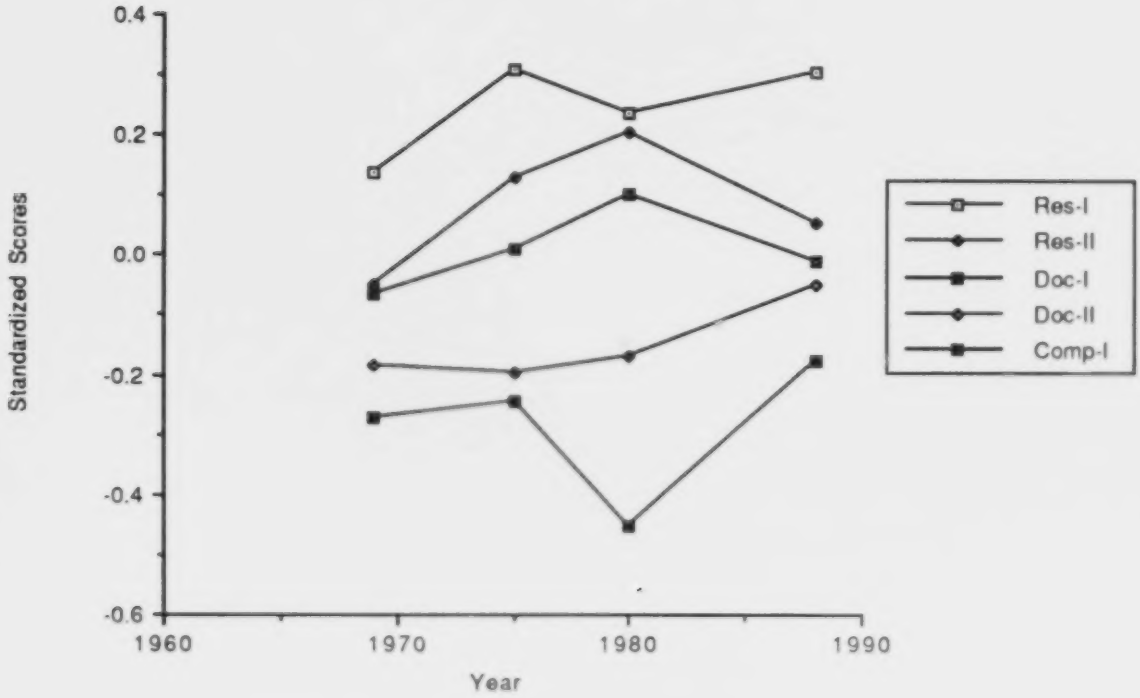

Figure 6: Percent Faculty with Sponsored Grant Support

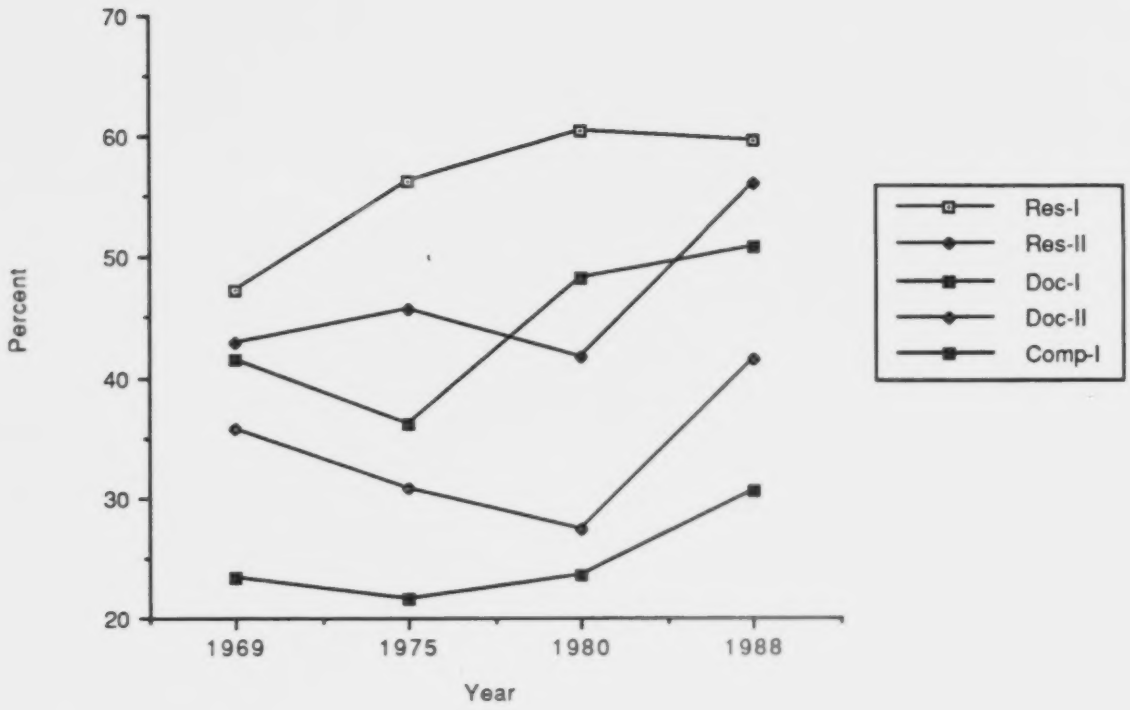

Figure 7. Standardized Sponsored Grants

(Adjusted for Differences by Discipline)

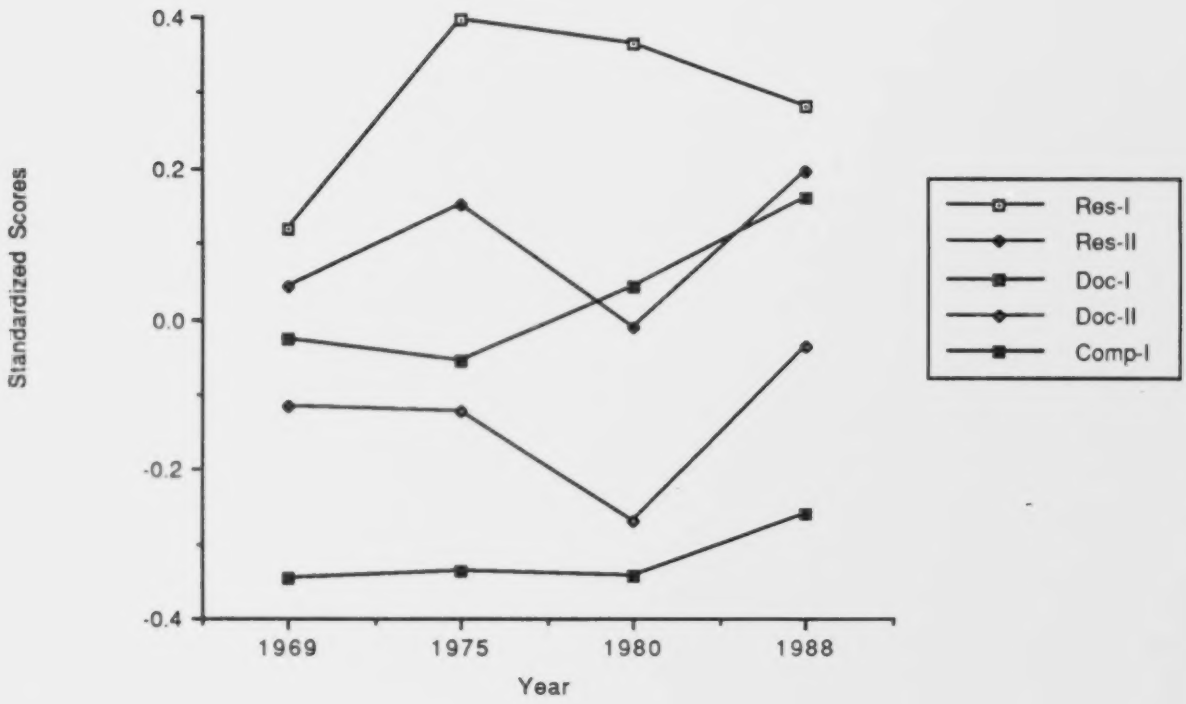

Figure 8: Aggregate Publication and Grant Productivity

(Adjusted for Differences by Discipline)

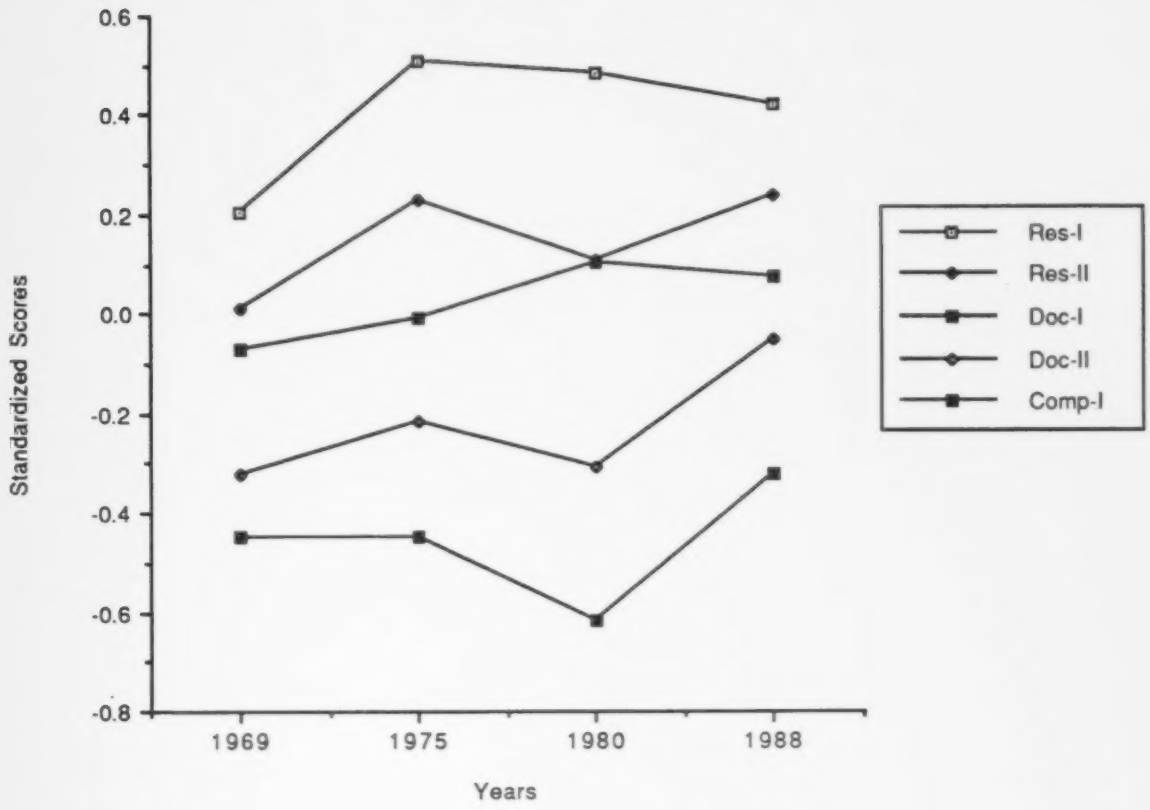

TABLE 1. NUMBER OF INSTITUTIONS IN EACH SUBSAMPLE

CARNEGIE TYPE	1969		1975		1980		1988	
	N	%	N	%	N	%	N	%
Res-I	30	25.6%	30	21.6%	7	19.4%	7	15.2%
Res-II	15	12.8%	20	14.4%	6	16.7%	3	6.5%
Doc-I	28	23.9%	16	11.5%	7	19.4%	5	10.9%
Doc-II	10	8.5%	19	13.7%	4	11.1%	6	13.0%
Comp-I	34	29.1%	54	38.8%	12	33.3%	25	54.3%
Total	117		139		36		46	

NOTE: The Carnegie classification was set up in 1973 and revised in 1976 and 1987. The 1969 data use the 1973 classification; the 1975 and 1980 data use the 1976 classification; and the 1988 data use the 1987 classification.

TABLE 2. DISTRIBUTION OF FACULTY SUBSAMPLES BY CARNEGIE INSTITUTION

CARNEGIE TYPE	1969		1975		1980		1988	
	N	%	N	%	N	%	N	%
Res-I	1432	45.2%	994	28.2%	409	27.4%	579	24.3%
Res-II	479	15.1%	602	17.1%	264	17.7%	241	10.1%
Doc-I	639	20.2%	287	8.1%	321	21.5%	296	12.4%
Doc-II	178	5.6%	389	11.0%	150	10.0%	311	13.1%
Comp-I	438	13.8%	1251	35.5%	349	23.4%	956	40.1%
Total	3166		3523		1493		2383	
Original Survey N	20,008 (1)		25,062		9,351		3,972	
Subsample %	15.8%		14.1%		16.0%		60.0% (2)	

NOTE: Data include all faculty holding academic rank of assistant, associate, or full professor in eight departments (biology, chemistry, English, history, mathematics, political science, and psychology) at research, doctoral, and comprehensive-I institutions.

(1) The 1969 data is a one-third random sample of the original N of 60,028.
(2) The 1988 survey sampled the eight departments that are included in this subsample. This is why the subsample is comparably larger than the other surveys which surveyed faculty from all disciplines and professional schools.

APPENDIX A

TABLE A-1. PERCENT OF FACULTY HOLDING PH.D'S
BY CARNEGIE INSTITUTION TYPE, 1969 TO 1988

CARNEGIE TYPE	1969	1975	1980	1988
	(N=3166)	(N=3523)	(N=1493)	(N=2383)
	%	%	%	%
Res-I	92.9	95.7	96.6	98.3
Res-II	88.7	93.3	93.5	97.1
Doc-I	91.8	95.0	95.1	93.9
Doc-II	83.6	89.5	93.0	93.6
Comp-I	74.1	84.4	86.4	87.3

NOTE: Data include all faculty holding academic rank of assistant, associate, or full professor in biology, chemistry, English, history, mathematics, political science, and psychology.

TABLE A-2. PERCENT OF FACULTY PRIMARILY INTERESTED IN RESEARCH (1)

CARNEGIE TYPE	1969	1975	1980	1988
	%	%		%
Res-I	57.3	67.9	Data not in 1980 Survey	78.7
Res-II	50.2	57.9		69.1
Doc-I	45.4	54.2		51.4
Doc-II	25.8	40.8		48.4
Comp-I	21.5	27.2		25.3

NOTE: Data include all faculty holding academic rank of assistant, associate, or full professor in biology, chemistry, English, history, mathematics, political science, and psychology.

(1) Faculty reported interests either "very heavily in research" or "in both (teaching and research) but leaning toward research."

TABLE A-3. MEAN FACULTY TWO YEAR PUBLICATION COUNT

CARNEGIE TYPE	1969	1975	1980	1988
	Mean	Mean	Mean	Mean
Res-I	3.7	4.2	5.0	5.4
Res-II	3.2	3.2	3.7	4.8
Doc-I	2.9	2.8	3.9	3.2
Doc-II	2.1	2.6	2.8	3.0
Comp-I	1.7	2.2	1.7	2.0

NOTE: Data include all faculty holding academic rank of assistant, associate, or full professor in biology, chemistry, English, history, mathematics, political science, and psychology.

TABLE A-4. STANDARDIZED FACULTY TWO YEAR PUBLICATION RATES (1)

CARNEGIE TYPE	1969	1975	1980	1988
	Mean	Mean	Mean	Mean
Res-I	0.190	0.416	0.446	0.530
Res-II	0.033	0.224	0.078	0.361
Doc-I	-0.056	0.031	0.035	0.096
Doc-II	-0.325	-0.152	-0.220	-0.010
Comp-I	-0.444	-0.398	-0.527	-0.438
F Ratio	42.9	116.6	54.7	116.8
Probability	0.000	0.000	0.000	0.000

NOTE: Data include all faculty holding academic rank of assistant, associate, or full professor in eight departments (biology, chemistry, English, history, mathematics, political science, and psychology) at research, doctoral, and comprehensive-I institutions.

(1) Standardized scores were created separately for each of the eight departments to account for differences by discipline.

TABLE A-5. MEAN FACULTY LIFETIME BOOK PUBLICATIONS

CARNEGIE TYPE	1969	1975	1980	1988
	Mean	Mean	Mean	Mean
Res-I	1.4	1.7	2.1	2.0
Res-II	1.1	1.4	2.0	1.6
Doc-I	1.1	1.2	1.8	1.5
Doc-II	0.8	0.9	1.4	1.4
Comp-I	0.9	0.8	0.9	1.1
F Ratio	15.2	52.4	29.0	25.8
Probability	0.000	0.000	0.000	0.000

NOTE: Data include all faculty holding academic rank of assistant, associate, or full professor in eight departments (biology, chemistry, English, history, mathematics, political science, and psychology) at research, doctoral, and comprehensive-I institutions.

TABLE A-6. STANDARDIZED LIFETIME BOOK PUBLICATIONS (1)

CARNEGIE TYPE	1969	1975	1980	1988
	Mean	Mean	Mean	Mean
Res-I	0.137	0.308	0.235	0.305
Res-II	-0.048	0.130	0.205	0.052
Doc-I	-0.068	0.010	0.103	-0.011
Doc-II	-0.185	-0.199	-0.169	-0.048
Comp-I	-0.275	-0.247	-0.452	-0.178
F Ratio	15.6	52.3	30.9	22.8
Probability	0.000	0.000	0.000	0.000

NOTE: Data include all faculty holding academic rank of assistant, associate, or full professor in eight departments (biology, chemistry, English, history, mathematics, political science, and psychology) at research, doctoral, and comprehensive-I institutions.

(1) Standardized z scores were created separately for each of the eight departments to account for differences by discipline.

TABLE A-7. PERCENT OF FACULTY RECEIVING SPONSORED GRANT SUPPORT (1)

CARNEGIE TYPE	1969	1975	1980	1988
	%	%	%	%
Res-I	47.2	56.3	60.4	59.7
Res-II	43.0	45.7	41.7	56.0
Doc-I	41.6	36.2	48.3	50.9
Doc-II	35.8	30.8	27.3	41.5
Comp-I	23.4	21.6	23.5	30.5

NOTE: Data include all faculty holding academic rank of assistant, associate, or full professor in eight departments (biology, chemistry, English, history, mathematics, political science, and psychology) at research, doctoral, and comprehensive-I institutions.

(1) Self-reported sources of external support include federal and state government, foundations, industry, and other sources received within the past year.

TABLE A-8. STANDARDIZED FACULTY SPONSORED GRANT SUPPORT (1)

CARNEGIE TYPE	1969	1975	1980	1988
	Mean	Mean	Mean	Mean
Res-I	0.118	0.396	0.364	0.282
Res-II	0.043	0.150	-0.010	0.195
Doc-I	-0.027	-0.055	0.044	0.162
Doc-II	-0.115	-0.124	-0.269	-0.036
Comp-I	-0.347	-0.336	-0.344	-0.259
F Ratio				
Probability				

NOTE: Data include all faculty holding academic rank of assistant, associate, or full professor in eight departments (biology, chemistry, English, history, mathematics, political science, and psychology) at research, doctoral, and comprehensive-I institutions.

(1) Standardized scores were created separately for each of the eight departments to account for differences by discipline. Self-reported support includes federal and state government, industry, foundations, and other sources received within the past year.

TABLE A-9. AGGREGATE FACULTY PUBLICATION AND GRANT PRODUCTIVITY (1)

CARNEGIE TYPE	1969	1975	1980	1988
	Mean	Mean	Mean	Mean
Res-I	0.185	0.489	0.423	0.441
Res-II	0.014	0.180	0.041	0.220
Doc-I	-0.077	-0.024	0.092	0.177
Doc-II	-0.240	-0.185	-0.214	-0.057
Comp-I	-0.413	-0.412	-0.519	-0.358
F Ratio	35.9	139.9	50.1	71.9
Probability	0.000	0.000	0.000	0.000

NOTE: Data include all faculty holding academic rank of assistant, associate, or full professor in eight departments (biology, chemistry, English, history, mathematics, political science, and psychology) at research, doctoral, and comprehensive-I institutions.

(1) Standardized z scores were created separately for each of the eight departments to account for differences by discipline. Publications include two year publications and lifetime books published while grants include federal and state government, industry, foundations, or other sources (1=yes; 0=no).

TABLE A-10. SCHEFFE TESTS ON SPONSORED GRANTS; TWO YEAR PUBLICATIONS; TOTAL BOOKS; AND AGGREGATE GRANTS AND PUBLICATIONS, 1969 TO 1988

	Comp-I	Doc-II	Doc-I	Res-II
ALL GRANTS				
Comp-I				
Doc-II	75 88			
Doc-I	69 75 80 88	80		
Res-II	69 75 80 88	75		
Res-I	69 75 80 88	75 80 88	69 75 80	75 80
TWO YEAR PUBS				
Comp-I				
Doc-II	75 80 88			
Doc-I	69 75 80 88	69		
Res-II	69 75 80 88	69 75 80 88	88	
Res-I	69 75 80 88	69 75 80 88	69 75 80 88	75 80
BOOKS				
Comp-I				
Doc-II				
Doc-I	75 80			
Res-II	75 80 88	75 80		
Res-I	69 75 80 88	69 75 80 88	69 75 88	69 75 88
ALL PUBLICATIONS & GRANTS				
Comp-I				
Doc-II	75 80 88			
Doc-I	69 75 80 88			
Res-II	69 75 80 88	75 80 88		
Res-I	69 75 80 88	69 75 80 88	69 75 80 88	69 75 80

NOTE: Sheffe test denotes pairs of Carnegie groups significantly different at the .05 level. Significant differences are identified by survey year (e.g., 75=1975 survey data).

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